

INDUCEMENT OF HETEROCHRONIC VARIATION IN A SPECIES OF PLANKTIC FORAMINIFERA BY A LATE EOCENE IMPACT EVENT; N. MacLeod and J.A. Kitchell, Department of Geological Sciences and Museum of Paleontology, University of Michigan, Ann Arbor, MI 48109

While it is well known that the cosmic impact event at or near the Cretaceous-Tertiary boundary coincides with an interval of mass extinction, a similar impact (or series of impacts) near the Eocene-Oligocene boundary presents a more complex picture, in terms of associated fluctuations in marine biotic diversity (1). Tektites, microtektites, and mineral grains exhibiting features of shock metamorphism found in Eocene sediments of the western N. Atlantic, Caribbean, and Gulf of Mexico (comprising the North American microtektite strewn field) offer compelling evidence for a catastrophic impact event (2-4). Despite the magnitude of this event, however, few extinctions in the planktic marine fauna are known to have occurred coincident with this event. Instead, changes in relative abundance, morphology, and development occurred.

At DSDP Site 612 (considered the site closest to the impact), the planktic foraminiferan species Subbotina linaperta exhibits a marked increase in abundance and a decrease in size at a stratigraphic level coincident with the occurrence of tektites and microtektites in the section. By contrast, at Site 94 (on the periphery of the North American microtektite strewn field) and also at Site 363 (outside the North American microtektite strewn field) no changes in relative abundance or size are evident within the same interval. Further, even following the microtektite interval at Site 612, S. linaperta maintains well below average test sizes, at least throughout the remainder of the Late Eocene. This substantial size decrease within a localized population represents selection for rapid sexual maturation, as evidenced by a shift in the size at gametogenesis and thereby representative of a heterochronic response (termed progenesis) to catastrophic environmental variation presumably brought about by the impact event. ¹⁸O isotopic analyses confirm that these smaller-sized, post-impact (progenetic) populations completed their life cycles at substantially shallower depths than corresponding South Atlantic populations.

Cosmic impacts generally have been interpreted as influencing the course of evolution through the wholesale elimination of significant portions of standing biotic diversity. Indeed, extinction traditionally has been viewed as the negative side of evolution. We suggest that, in some instances, such impact events can serve instead to increase, rather than decrease, morphological and ecological diversity, by altering the developmental programs within species at the level of the local population.

References:

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